The Institution of Engineering and Technology

ITS United Kingdom
Better transport through technology

Meeting the **Needs of Older and Disabled** Travellers

A Factfile provided by **The Institution of Engineering and Technology** and **ITS(UK)**

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Key messages

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ITS United Kingdom

Intelligent Transport Systems (ITS) is the integration of information and communications technology with transport infrastructure, vehicles and users.

ITS United Kingdom is the UK organisation for all who work in ITS. It is a not-for-profit public/private sector association financed by members' subscriptions. ITS (UK) provide a forum for all organisations concerned with ITS.

ITS (UK) works to bring the benefits that ITS can offer in terms of economic efficiency, transport safety, and environmental benefits to the United Kingdom. The membership, over 160 organisations, comprises Government Departments, Local Authorities, Police Forces, transport operators, consultants, manufacturing and service companies, and academic institutions.

New members are always welcome and benefit from activities including seminars, workshops and regular news dissemination. ITS United Kingdom encourages discussion on issues such as public/private co-operation, standards, legislation, information provision and new technology.

Find out more at http://www.its-uk.org.uk

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Contents

Executive Summary - Key Issues

Improvements to physical infrastructure and service provision have undoubtedly enhanced public transport accessibility and thus mobility in recent years. However, it is the rapid growth of new technologies that must now be embraced in order to facilitate fully independent travel for older and disabled people.

These new technologies, which can be categorised under the term Intelligent Transport Systems (ITS) can act as the 'glue' for accessible transport networks.

There are two clear challenges. Firstly, whilst the guidance enshrined in the Equality Act, the PSVAR and RVAR, and the Department for Transport's *Inclusive mobility best practice guide*, offers a platform to help inform what needs to be considered in terms of inclusive approaches, technology-based solutions do not feature in any great detail in these guidance sets. Both vehicle and infrastructure designers use these guides to define what constitutes an accessible vehicle/environment and therefore the guidelines need to be updated to incorporate the huge potential technology has in improving mobility.

Secondly, the significant potential of services delivered to personal portable devices has yet to be realised. Smart phones and apps can give users up-to-date data on their travel and enable them to make decisions based on their needs. The slow uptake of these technologies by the older and disabled population means that a section of society that can benefit most from these services is missing out.

Despite ITS being deployed at system or network-level there are still significant gaps to be addressed and solutions must be developed in three key areas:

- Support for independent travel for the elderly and disabled
- Cost effectiveness and efficiency of the current system for the provider and end user
- Provision of seamless, reliable, multi-modal (and multi-operator) journey information

Full stakeholder engagement is required between industry, operators, Government, engineering professionals and the user, to enable a joined up approach to inclusive mobility that places the user's needs at the heart of the mobility plan.

Addressing these issues will offer enormous scope in improving the mobility, health, and wellbeing of not only disabled and older people, but all members of society. Failure to do so risks a growing part of the wider population being excluded from basic human rights of independence, mobility, and social inclusion.

1. Introduction

1.1 Incidence of disability and ageing in the UK

There are 11.2 million disabled people in the UK in a total population of 62 million (Department for Work and Pensions, 2012). Of these, 57% are mobility impaired, 25% dexterity impaired, 21% cognitively impaired, and 18% communication impaired. The UK population is also ageing and growing. By 2035 the proportion of the population over 60 will have risen from 22.9% to 28.6% with more people working into old age, whilst the number of people aged over 80 will also increase (Office for National Statistics, 2011). As the population ages the likelihood of impairment rises: around 6% of children are disabled compared to 16% of working age adults and 45% of adults over state pension age (Office for Disability Issues, 2011). 20% of people aged 75 and over are living with sight loss, climbing to 50% of people aged over 90 (see https://www.rnib.org.uk/).

1.2 How UK policy addresses disabled and older people's mobility

Although disabled people rely on public transport to access jobs, services, facilities, family and friends, approximately 20% report difficulties in using transport (Penfold *et al*, 2008). This constitutes a lack of mobility that can result in loss of independence and thus social exclusion, reduced economic contribution and diminished quality of life (Social Exclusion Unit, 2003; Metz, 2003; Banister and Bowling, 2004; Stanley *et al*, 2011; Department for Transport, 2012a; European Commission, 2010a).

Much effort has rightly been focused on modifications to physical infrastructure, vehicles and services, in order to enhance their accessibility. Policy and legislation have defined the duties of care of transport service providers towards disabled and older people. The Equality Act 2010 requires reasonable adjustments to provide services for disabled people, and to ensure that vehicles comply with regulations (PSVAR, 2000; RVAR, 2010; PRM TSI, Directive 2008/164/EC). All buses will be compliant with PSVAR by 2017, all coaches by 2020. 41% of rail vehicles are currently accessible (RVAR and PRM TSI) (see **Figure 1**). This figure is lower than taxis and buses which in general are replaced more frequently than rail vehicles, which often have lifespans of 30 years or more. However, all rail vehicles will be accessible by 2020.

There are provisions in the Equality Act to ensure guide dogs are transported by taxis and private hire vehicles, with forthcoming provisions for wheelchair users.

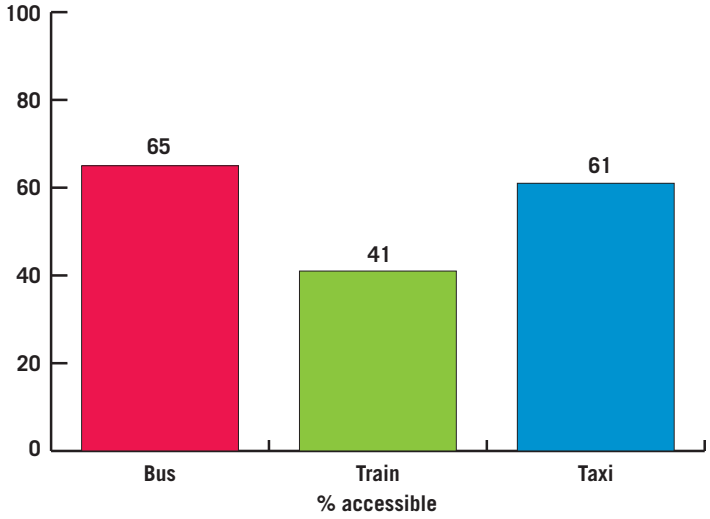

Figure 1: Accessibility of UK public transport vehicles 2013

The key guidance standard applied for a transport-related built environment is the Department for Transport's *Inclusive Mobility: a guide to best practice on access to pedestrian and transport infrastructure* (Department for Transport, 2005). Meanwhile the Access for All programme has invested £400m in railway stations since 2005, with a further £100m committed until 2019. By that date 75% of journeys will start or end at a fully accessible station.

The Local Transport Act (2008) improved scope for provision of community transport, whilst concessionary travel measures such as free off peak bus travel for disabled and older people and the disabled person's

railcard offering one third off rail tickets, go some way to addressing the affordability of public transport (Department for Transport, 2012a).

The UK Department for Transport recently published the **Accessibility Action Plan** (Department for Transport, 2012b) to "deliver better access to jobs and key services through an accessible and socially inclusive transport system, by removing the barriers to travel and ensuring that social impacts are addressed in policy development and service delivery". Three key areas are identified for future improvement: physical accessibility, information provision, and attitudes and behaviour by and towards staff as key areas for future improvement.

1.2.1 Improving physical accessibility

Physical accessibility is central to the ease of use of public transport, and thus to people's mobility. It relates to design aspects of vehicles, infrastructure (including stations, stops and equipment such as ticket vending machines (TVMs)), and the on-street approaches. Many disabled and older people are not able to walk the required distance, stand for a long time or have the overall physical endurance to use public transport; therefore lack of amenities such as covered waiting areas, seating and toilets can detract from a service.

1.2.2 Information provision

Information is a fundamental aspect of travel and includes at-stop/station and on-vehicle displays, delivery in a variety of formats to the individual via personal portable devices, or in more conventional manner through paper timetables or phone-based information centres (Department for Transport, 2012a). Technology, in particular internet-based services, can help with pre-trip planning and (where internet-enabled portable devices are available) on-trip planning, so that trip-makers can adjust their journey for any reason, be it social, emergency, or change of plan. However, there are two key issues: firstly, the reliability and completeness of the information, which should be real-time and up-to-date; secondly, the (slow) adoption of information communication technology (ICT) by disabled and older people. 61% of disabled people live in households with internet access, compared to 86% of non-disabled people (Office for Disability Issues, 2011). **Table 1** below shows the results of a survey asking whether older people are likely to embrace smartphone-based technology for accessing travel information. Amongst this demographic there remains reliance on at-stop/ station, on-vehicle displays, and traditional information sources.

Would you use the following if they were available through your mobile phone?	**Age group of respondents**		
	60-64	65-74	75+
Journey planning website	6.9%	3.2%	0%
Text messages giving departure times	10.3%	9.7%	15%
A dedicated app	0%	0%	0%
None of the above	82.8%	85.5%	85%

Table 1: Information access through smartphone-based technology, a household survey by NEXUS
(Source: ASSISTANT project http://www.aal-assistant.eu/**)**

1.2.3 Operational practice - the human factor

Even when physical and informational barriers are addressed there may still be psychological barriers. Uncertainty about any aspect of travel can deter someone from making a trip. Travel training can enhance one's familiarity with the overall trip experience, and thus reduce uncertainty and engender confidence. A bad experience with a member of staff or fellow passenger can have the opposite effect. Therefore training of transport providers is beneficial (Penfold *et al*, 2008; Department for Transport, 2012b). As an example, the nature of older people's impairments means they are not necessarily apparent to other passengers or staff. Priority seating exists, but it may not be obvious to others that an older customer has a real need. The understanding of staff and fellow passengers is required, and to assist with this many operators have implemented priority cards (e.g. Nexus' "Bridge Card") which inform others of a customer's specific need for assistance, and in some cases, entitle the holder to a dedicated priority seat.

Mobility contributes to social inclusion and thus wellbeing, benefits the economy and reduces healthcare provision (Stanley *et al*, 2011; DfT, 2012a; EC COM(2010) 636 final). Efficient movement of people enhances communication, exchange and overall social cohesion, making seamless and inclusive mobility essential to society (DfT, 2012b; EC COM(2010) 636 final). The ultimate goal is a seamless multi-modal door-to-door trip that is safe and secure for everyone. If even one element of the trip is inaccessible, the trip as a whole becomes inaccessible, and may not be made.

Powerful economic and social arguments exist for enhancing transport accessibility for older and disabled people, and these are reinforced through legislation and demographic trends toward an ageing society. Whilst much effort has focused on modifications to physical infrastructure, vehicles and services to enhance their accessibility, the emergence of new technologies offers the potential for further accessibility improvements. This factfile explores the role of new technologies, commonly referred to as Intelligent Transport Systems (ITS), with particular emphasis on information services and their access through portable devices. It proceeds to discuss how new technologies, and their appropriate application and implementation for the benefit of older and disabled transport users, can be optimised through better stakeholder engagement. Making the best use of technology for enhancing transport accessibility is a challenge, but one that if met, offers enormous scope to improve mobility, health, and wellbeing, not only for disabled and older people, but for all members of society.

1.3 The focus of this factfile

Whilst the Department of Transport's Action Plan's focus on physical accessibility and the human aspects of operational practice is essential, it is technological opportunities collectively referred to as Intelligent Transport Systems (ITS) that offer potential solutions to public transport inaccessibility. In this factfile focus is placed on another Action Plan priority area - information provision - and in particular the use of portable devices for accessing a range of personalised services. It initially discusses ways in which enhanced stakeholder engagement can enable new technologies to be appropriately implemented for the benefit of older and disabled transport users before providing an overview of system-based ITS (e.g. information services, positioning, routeing, way-finding), and then reviewing bespoke personal portable technologies. The paper concludes with a look at future technologies, and their appropriate application and implementation, along with recommendations for technology-enabled independent trip-making.

2. Stakeholders

2.1 Who are the Key Stakeholders?

Central Government (via Department for Transport) published a series of actions in their Equality and Accessibility Action Plans (December 2012) to further improve access to transport for people identified as belonging to a Protected Characteristic under the Equality Act 2010. Both Action Plans detail a collective and collaborative approach for the public/private sector to address issues surrounding use of new and emerging technologies to improve access to transport, especially in relation to older and disabled people. There are three questions for consideration:

- Are all the necessary stakeholders effectively and efficiently engaged in undertaking work to design and deliver effective outcomes for the Central Government led action points?
- Does a robust single platform at national level exist to enable all stakeholders to work collaboratively to deliver fit for purpose solutions to enable Central Government to achieve Action Plan objectives? Arguably, the ITS (UK) sponsored Inclusive Mobility Interest Group is the only current means in the UK to offer this.
- Are wider sectors (Academic and Third Sector - for example RNIB) appropriately and adequately aligned with existing platforms to provide current and emerging expert knowledge to help ensure that a 'joined up' approach optimises all current knowledge in order to create effective solutions?

2.2 Are the right people involved?

Overall, whilst it could be argued that much is in place to successfully progress technology based solutions to help connect disabled and older people with places, it would appear that a lack of joined up approach hampers progress; indeed, not all parties are signed up to a central platform, or aware of each other. For example, Industry wouldn't necessarily look to the Royal National Institute of the Blind (RNIB) for advice and guidance in terms of what should be considered in order to ensure that products and software are accessible to visually impaired people. Likewise, a question needs to be asked of whether leading experts in the fields of ageing and disability have the correct linkage with industry to share and disseminate knowledge to further improve technology. A further area for consideration is how best to adopt a solution-based approach via meaningful, appropriate consultation with user groups. A common concern which is often raised by disabled people is that consultation does not take place with user groups until products have been signed off, by which point it is often too late to make (often small and practical) changes to further improve products for end users, who are ultimately the customers.

A good way forward would be to involve Third Sector stakeholders such as the Royal National Institute for the Blind (RNIB) at the concept design, product development and project close out stages. This would promote a 'joined up' approach thereby optimising all current knowledge to create effective solutions. At the present industry doesn't instinctively consult RNIB for advice and guidance to ensure that products and software are accessible to visually impaired people. However Third Sector stakeholder organisations often collaborate closely with end users and offer technology training etc. providing an enhanced opportunity for product designers and developers to support the evolution of products for use by as many customers as possible.

This approach has been proven to work in other areas as this group of stakeholders often have access to technically minded users with product experience, and can therefore offer an enhanced opportunity for product designers and developers to support the evolution of products for use by as many customers as possible. A further advantage, identified by the NICHES+ project (2008-11), is that active user representation on product and service design, development and implementation, engages end users with the product or service to the extent that they can assume a marketing role in increasing uptake simply by spreading the word (NICHES+, 2010).

A further issue which is significantly overlooked is that of training for older and disabled people in the use of modern mobile phones and apps. Currently, the ratio of people of non-retired age to that of retired age is around 3.7/1. By 2050, it is anticipated that this will be only 2/1, which therefore represents not just a substantial rise in the older population, but also a shift in populations in older age to advanced old age (Office for National Statistics, 2011). Evidence exists that some third sector organisations (for example, Henshaws Society for Blind People (see http://henshaws.org.uk/)) offer training for visually impaired people, many of whom are of advanced old age, in the use of i-phones, but this is the exception rather than the rule. The only training scheme of its kind currently known to exist is in the Greater Manchester region.

2.3 How do current approaches work, and where do they fail?

Following the introduction of Part V of (what was) the Disability Discrimination Act (2005), transport and the associated built environment has improved considerably. Standards and guidance exist to define what accessible transport needs to conform to (Public Service Vehicle Accessibility Regulations 2000 and Rail Vehicle Accessibility Regulations 1998/2010), whereas the key guidance standard used for a transport related built environment is the DfT's *Inclusive Mobility: A guide to best practice on access to pedestrian and transport infrastructure*.

Whilst the guidance offers a platform to help inform what needs to be considered in terms of inclusive approaches, technology based solutions do not feature in any great detail in these guidance sets. This is a key point which needs to be made as both vehicles and infrastructure use these guidance sets to define what makes an accessible vehicle/environment.

Mobile phone technology has evolved at an incredible rate over the last 10-15 years. Whilst this is clearly successful from a commercial perspective, unknowns still exist in terms of the extent mobile phones and integrated software can be evidenced to offer a useful means to empower disabled people of all ages to make an independent journey. A question therefore needs to be asked whether this type of technology is developing in the right direction, and if so, does a suitable common model exist which could be used to define what needs to be considered to ensure that advances in mobile phone technology help to fill the independent travel gaps currently known to exist.

3. Intelligent Transport Systems

Intelligent Transport Systems (ITS) have revolutionised transport, both private and public. This trend is set to continue with a European Directive 2010/40/EU enshrining deployment of ITS in the field of road transport and for interfaces with other modes throughout the continent (European Commission, 2010b).

In its broadest sense ITS is the application of computerised systems, including information communications technology (ICT), to transport. They range from the cooperative level, for example assisting drivers, fleet managers and traffic managers through systems like traffic signals, fleet management systems, and communications between vehicles and roadside infrastructure, to systems and services such as the provision of online information, electronic ticketing, and smartphone apps that are designed to make individuals better informed, enabling faster, easier travel by public transport.

3.1 How ITS can benefit trip-makers

When individuals are considering a trip, they need to be able to:

- Find an event or venue information
- Plan the trip
- Purchase the ticket
- Make the trip (one or more transport modes may be required and service disruption may be encountered)
- Find the venue
- Move around the venue, and locate facilities

A trip thus involves several different components and usually more than one mode (including walking), taking an individual from their front door to their destination and return. Planning the trip requires pre-trip and on-trip information.

For older and disabled people with a diverse range of impairments the trip becomes even more complex. It is people with severe visual impairments or blindness who arguably face the greatest challenges to accessing this pre-trip and on-trip information. For this group, further considerations impact on pre-trip and on-trip planning. Examples (non-exhaustive) include: the availability of assistance if required; pre-booking of assistance or other services; weather conditions; signage, maps and information delivery in appropriate colour contrast, Braille or spoken word; quality of surfaces (e.g. tactile pavements); and availability of people to ask for help. The Royal National Institute of Blind People (RNIB) in its Wayfinding project (Worsfold and Chandler, 2010) summarise the most important challenges for visually impaired people as:

- Getting information and using it
- Orientation
- Navigation
- Entrance/exit identification

In practical terms, if only one element of a trip is not accessible for an individual, the whole trip becomes difficult or even impossible to make. Unsurprisingly many people stick to tried-and-tested routes, modes, and trips or decide against making the trip at all.

Technology in the form of ITS may be able to provide a 'glue' to bind these different trip components, and where possible enfranchise the individual to take greater control of his or her trip experience, in other words become independent. However, there are still certain conditions necessary to make technology work for everyone:

- Interfaces must be user friendly and - where services to portable devices are concerned - have the ability to apply user-specified formats
- Content should be relevant, reliable, seamless, up-to-date, comprehensive, and understandable, including re-routing in the event of service disruption
- Additional location-based services should be available to connect the mechanics of a trip with the reasons for it taking place, in other words not only 'how do I get there', but 'what can I do when I get there'?

3.2 Journey planners

At a basic level, many technologies are in existence that can help support older and disabled people travel via public transport, however, such technologies often operate in isolation. A variety of internet-based journey planners exist, supplying static and dynamic information relating to single or multi-modal trips, including price comparisons and ticket booking facilities.

One of the best examples of a journey planner catering for the needs of older and disabled people was developed in Project BAIM (2005-8) and its follow up BAIM+ (2008-10) in Germany. Here, web-based information is provided on barrier-free public transportation trip chains in the Frankfurt and Berlin regions, with additional static information on the accessibility of vehicles, stops and stations. Project BAIM offers scope to expand across the EU by data mapping accessible environments, thus enabling people to plan a trip based on their individual requirements. With the advent of GPS-driven hand-held navigational aids, the concept of Project BAIM as a ready-made platform of internet-enabled information could provide travel opportunities which truly liberate people to travel independently (see http://www.ftb-net.com/baim.html).

3.3 Portable technologies

Mobile phone technology is becoming fundamental to fully flexible trip planning. This field has evolved considerably over the last 10-15 years, but its uptake by older people remains slower than for other demographics, as **Figure 2** shows.

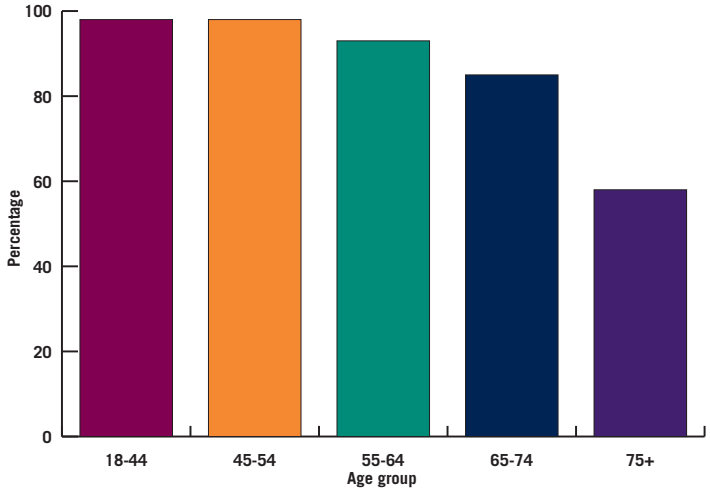

Figure 2: Proportion of individuals owning a mobile phone
(Source: ONS, 2013)

Ownership of smartphones is believed to be even less ubiquitous amongst disabled and older people, with only 2% of adults over 65 owning one in 2012 (Ofcom, 2012). Although smartphone technology is clearly successful from a commercial perspective, unknowns still exist in terms of the extent to which phones and integrated software can offer a useful means to empower disabled people of all ages to make an independent trip. A question therefore needs to be asked whether this type of technology is going in the right direction, and if so, does a suitable common model exist which could be used to define what needs to be considered to ensure that advances in this field contribute to independent travel. Feedback from users, in particular visually impaired people, raises concerns in terms of the three 'A's:

- Is the device and software **'accessible'**, especially in terms of user interface?
- Is it **'affordable'**, especially with regards to smartphone contracts?
- Is it **'available'** in terms of understanding of accessibility criteria by the retail sector to ensure 'fit for purpose' models for older and disabled people?

It is therefore useful at this point to discuss the specific needs of older and disabled people, illustrated with examples of how transport-related ICT-based systems have been developed for people with specific impairments.

4. Transport Technology Applications for Older and Disabled People

The Organisation for Economic Co-operation and Development (OECD 2003) provides a useful three-way division of transport technology applications for older and disabled people, as applied to a vehicle, a person or to the physical infrastructure. Those applied to the vehicle tend mostly to relate to private vehicles and driving so, given the focus of this paper on public transport, it is personal and physical infrastructure technologies that are most relevant.

4.1 Personal technologies

Personal technologies are being used to develop solutions for different disability groups. Whilst a great deal of effort has focused on technologies to assist visually impaired people, solutions have also targeted wheelchair users and others with reduced mobility, and people with hearing or other communications impairments.

Smartcards - this technology application provides for easier and more convenient transport-related payments, e.g. for public transport, for para-transit and/or for taxis. Smartcards remove the need to sort through coins or bank notes, something which can be difficult for those with impaired dexterity or sight/touch. Contactless smartcards, based on RFID technology, can even be used without requiring the user to remove the card from their pocket or wallet. Furthermore, smartcards can also be used to store customised accessibility-related information relating to the user, which could be shared with, for example, on-bus systems as a means of communicating with the driver.

Personal Navigation Aids - passenger guidance for visually impaired people seeks to make use of satellite navigation technologies in conjunction with screen magnification and speech synthesis technologies, in order to provide route navigation and wayfinding information to people with a visual impairment. Passenger guidance based on GPS and mapping technologies, often referred to as Personal Positioning Systems (PPS), has been implemented in two principal ways. Firstly, for much of the past two decades, implementation has been via specialist devices designed for visually impaired people with the dedicated purpose of providing passenger guidance; the Trekker Breeze is the most recent example of this (see **Figure 3**, and http://www.humanware.com).

Figure 3: Trekker Breeze
(image courtesy of HumanWare)

Whilst the portability of these devices has improved over time and their price has reduced their purchase price is still in the range €150-€400. Secondly, implementation has more recently been via applications (apps) designed for internet-enabled mobile phones and smartphones, since the required technologies are often already integral to the mobile device. A number of such apps exist, but three examples are:

- *Navigon* - this uses the mobile device's GPS capability and links with digital mapping to provide a fully-functioning mobile navigation system, enabling text to speech voice guidance, turn-by-turn pedestrian directions, a 'take me home' function, and links to the user's contact list to provide directions to a selected contact.
- *Blind Square* - uses the iPhone operating system device's GPS capability to determine the user's location, and then links with FourSquare and Open Street Map to look up and speak, in its synthetic voice, information about nearest street intersections, nearby shops, restaurants and other facilities, and distance travelled.
- *SeeingAssistant-Move* - launched in 2013, this provides for route planning and route recording, advanced neighbourhood scanning with world directions, location search, 'where-am-I' functionality, input of sharing points and use of voice commands (see **Figure 4**).

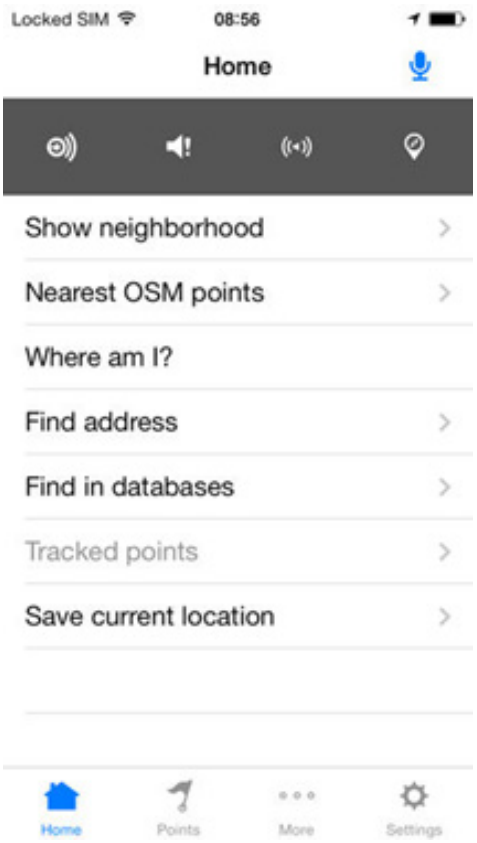

Figure 4: SeeingAssistant-Move
(image courtesy of SeeingAssistant-Move)

Furthermore, the RNIB have been conducting ground-breaking work in the areas of augmented reality, electronic recognition and artificial vision. They see these as forming part of a 'blended technological' solution, whereby technologies serve to complement techniques already being used, such as the long white cane and the guide dog.

Tailored accessibility-related information and communication apps for wheelchair users and people with otherwise reduced mobility draw on digital maps and crowd-sourced data, often provided in real time. Examples of some of these currently on the market are as follows:

- *Jaccede* - this app was launched in 2012 and enables users to search for places that are accessible to those with a disability. Information, such as whether the entrance is step-free, or accessibility of toilets, is displayed alongside photos, user comments and other relevant information. Users can contribute by adding accessible places anywhere in the world, or by editing existing listings. The app was a winner of a Vodafone Smart Accessibility 2012 award, in the mobility category (see **Figure 5**).

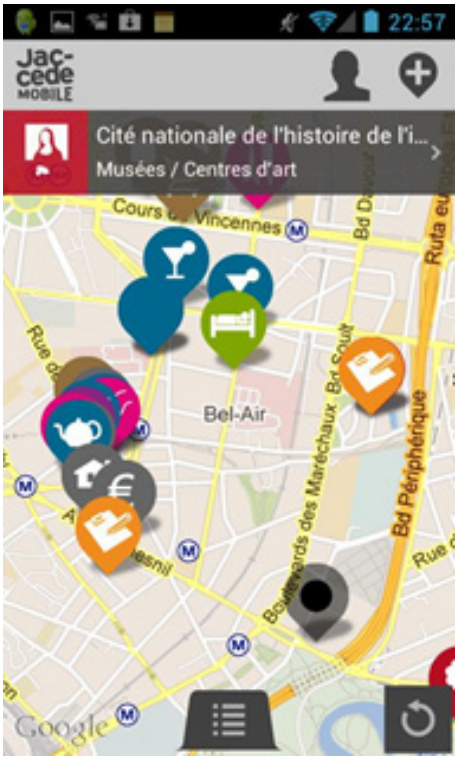

Figure 5: Jaccede interface
(image courtesy of Jaccede)

- *Assist-MI* - this app can be used by disabled people to alert participating sites such as shopping centres, railway stations and airports when they are on their way and when they have arrived, while conveying all their access needs so they can be met by staff and properly accommodated. In addition, the Parking Space Finder function can help locate nearby Blue Badge (disabled parking) spaces and indicate how far away the space is, any special parking restrictions the space may have, and what kind of parking it offers (see **Figure 6**).

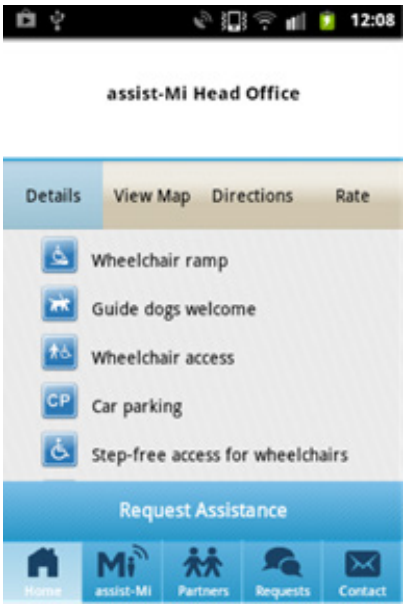

Figure 6: Assist-MI
(image courtesy of Assist-MI)

- *GoGenie* - this app aims to help disabled and deaf people find access information online for any location such as a shop, cinema, cultural event or town centre, based on the recommendations and comments of others. Specific features include access information, contacts, maps, facilities to add reviews, photos and videos, and a 'report-it' feature enabling people to complain directly to inaccessible venues and organisations.
- *Ldn Access* - this app is designed to be used as a source of access-related information for places to eat, hotels, entertainment, attractions and so on throughout London. It is targeted slightly more broadly at disabled people (either physical or non-physical or both), older people, visitors to London and families with young children, and provides information on wheelchair access, disabled toilets, induction loops, baby changing facilities, customer parking, etc.

4.2 Physical infrastructure technologies

New technologies have also been embedded into the physical infrastructure of the built environment. Triggered Information, via the use of beacons, has been the subject of research and development, and the RNIB has recently launched its update to their React system of talking beacons for visually impaired people. A further idea is that of 'electronic leadlines', whereby radio-frequency identification devices (RFID tags) are fitted to the visually impaired person or to their long white cane, which then interact with tags in the environment. The aim is to enable the visually impaired person to be prompted and guided in unknown environments, but it could also serve to improve cognitive awareness of one's surroundings. The Austrian 'ways4all' project has undertaken ground-breaking work in this area, establishing several demonstration sites in Vienna (see http://www.ways4all.at/index.php/en/). However, it is not possible to embed RFID tags everywhere, so the question returns to the issue of how to use what is already there to best effect.

5. Conclusion

From society's viewpoint mobility at its most inclusive contributes to social cohesion, wellbeing, reduces healthcare provision, and benefits the economy. From the individual's viewpoint the ultimate goal is a seamless multi-modal door-to-door trip that is safe and secure. If even one element of the trip is inaccessible, the trip as a whole becomes inaccessible, and may not be made.

5.1 The role of ITS

Whilst improvements to physical infrastructure and service provision have undoubtedly enhanced public transport accessibility and thus mobility in recent years, it is the rapid growth of new technologies that must now be embraced in order to facilitate fully independent travel for older and disabled people. These new technologies, which can be categorised under the term Intelligent Transport Systems (ITS), can act as 'glue' for accessible transport networks. There are two clear challenges. Firstly, whilst the guidance enshrined in the Equality Act, the PSVAR and RVAR, and the Department for Transport's *Inclusive mobility best practice guide* offers a platform to help inform what needs to be considered in terms of inclusive approaches, technology-based solutions do not feature in any great detail in these guidance sets. This is a key point which needs to be made as both vehicles and infrastructure use these guidance sets to define what constitutes an accessible vehicle/environment.

Secondly, the significant potential of services delivered to personal portable devices has yet to be realised. This is because of slow uptake of these technologies by the older and disabled population. This issue is being addressed by initiatives across Europe, one such being the ASSISTANT project (2012-15). This project aims to deliver travel support in planning a trip, guidance on which vehicle to board, notification of when to get off the vehicle, personalised, active help for dealing with disruptions and service alterations, and navigation assistance to final destination. Static data is available pertaining to accessibility of the transport system and the pedestrian environment, and the user is supplied with contextualised, customised services. Information is delivered to smartphones or home PC, with the ultimate goal to assist older people use public transport, enhancing comfort and confidence. Even so there are clear technical and organisational challenges which ASSISTANT will seek to overcome, including data acquisition, location prediction, and competing systems and services (see http://www.aal-assistant.eu/).

5.2 The challenges

As system or network-level ITS continue to be deployed and can benefit everyone, there are still gaps to be addressed. These include:

- Lack of accessible real time journey information
- Lack of accessible route mapping to help plan a journey
- Lack of a joined up approach to address issues known to exist
- Accessibility, affordability, and availability of current products and services

More urgently, solutions need to be developed in three key areas:

- Support for independent travel for the elderly and disabled
- Cost effectiveness and efficiency of the current system for the provider and end user
- Provision of seamless, reliable, multi-modal (and multi-operator) journey information

5.3 The next steps

Full stakeholder engagement is required between industry, operators, Government, engineering professional and the user, to enable a joined up approach to inclusive mobility that places the user's needs at the heart of the mobility plan. Addressing these issues will offer enormous scope in improving the mobility, health, and wellbeing of not only disabled and older people, but all members of society. Failure to do so risks a growing part of the wider population being excluded from basic human rights of independence, mobility, and social inclusion.

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